



# 자리 있나요? Empty Seats?

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Weekly progress meeting # 1

Team A (A's) 김도엽 박재윤 우다연 최지민

# Contents

:

**01**

Flesh out  
the details

**02**

Model  
testing

**03**

Basic  
implementation

**04**

LaTeX  
document

**05**

Future  
plans

# What has been done & roles

## 캡스톤 디자인 프로젝트

Table

회의록

Aa Name	Date	Files & media	회의 종류
0. 팀 빌딩 & 주제 방향성 논의	2023/09/08		
🔥 주제 회의	2023/09/09	https://docs.g...	
👉 주제 구체화 회의	2023/09/10		
🤔 모델 구현 아이디어 회의	2023/09/22		금요일 대면
🔥 역할 분담 및 세부 일정 조율	2023/09/25	Flow.xlsx	월요일 중
🔥 To Do & Done	2023/09/26	[Team A]Propo...	추가회의 대면
🕒 Weekly Progress (1) 발표 준비	2023/10/04		추가회의 대면

+ New

Table

To Do 일정 정리

September 2023

October

Month < Today >

24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Feedback

LINC 사업 계획서 제출

[Team A] Proposal written by LaTeX markdown

+ New

- 1

Flesh out the details

Everyone
- 2

Model testing

박재윤, 우다연, 최지민
- 3

Basic implementation

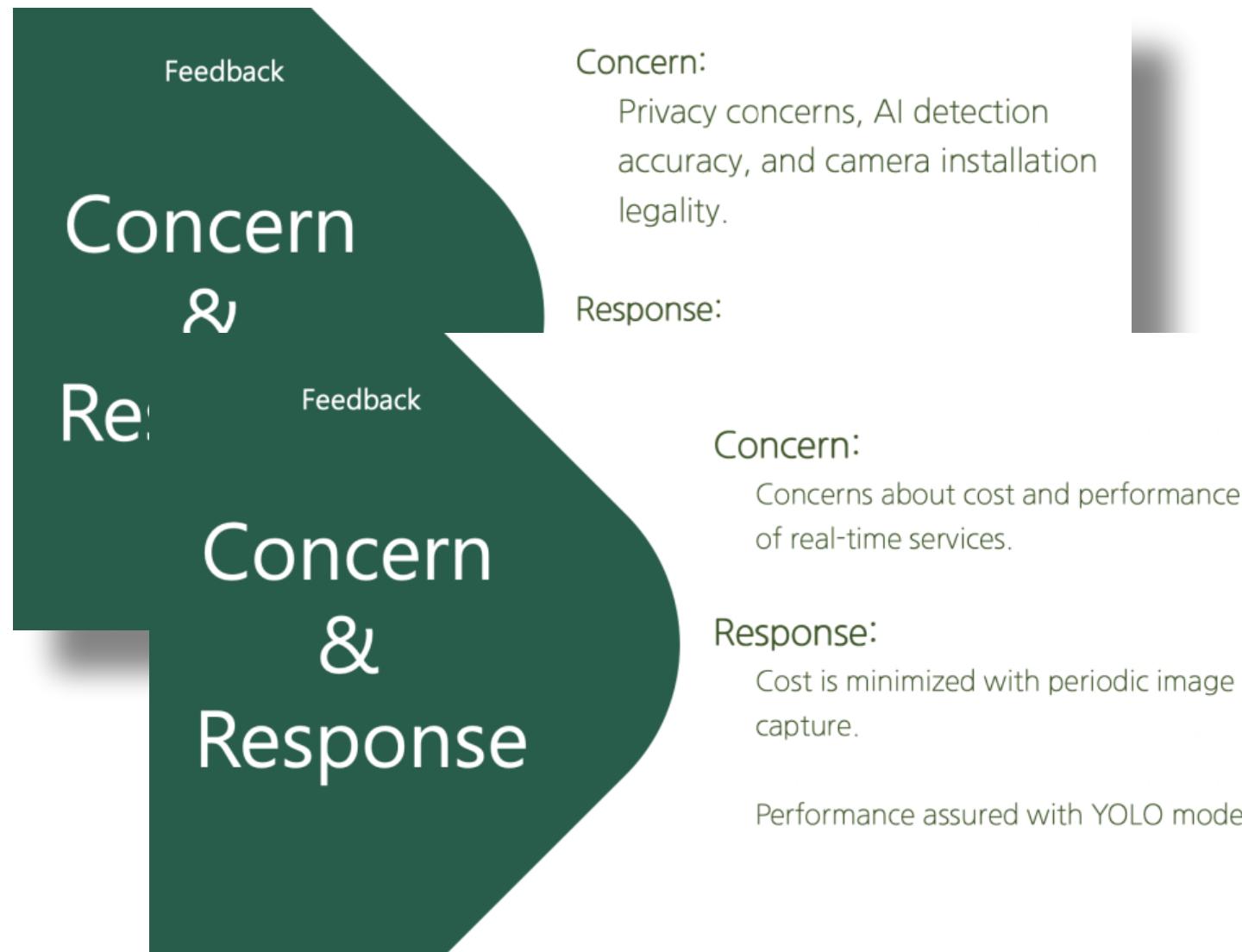
김도엽
- 4

LaTeX document

Everyone

# PART 01 | Flesh out the details

## Proposal feedback



## Previous research study

- ▼ library seat detection (2018.12)
  - Approach 1: Pre-training
    - 자리 세 단계 구분
      - ▼ 콜롬비아 대학교
      - Columbia University EECS E4764 IoT Project Report #11
      - This project is an attempt to determine seat occupancy of a class room, hall, library etc.
      - <http://icarl.ee.columbia.edu/iot-class/2016fall/group11/>
    - CO CN
    - 데이터셋 & 모델 관련 정보 x
  - 고정된 위치의 단일 좌석부터 점진적으로 detection 구현함
    - 1단계: single seat at a fixed position
      - face detection algorithm: based on Haar-like cascade features (명암대비)
    - 2단계: multiple seats with fixed position
      - color based detection: 색깔로 의자 구분 (어떤 좌석이 차 있는지 구분하기 위해 각 좌석 별로 다른 색의 종이를 부착해 둠. 색을 인지해서 각 좌석의 상태를 탐지함)
      - 의자 detection 후 face detection 으로 자리 상태 탐지
    - 3단계: movement of the seat and detecting its movement and position
      - color based detection
      - face detection

# PART 01 | Flesh out the details

⇒ Task segmentation

	Depth 0	Depth 1	Depth 2	Depth 3	Depth 4		
level 0	Data input	Data local 전송					
level 1	디텍팅	자리	사람	이동중 않은상태 부재중	TRUE	TRUE TRUE FALSE	TRUE TRUE FALSE
level 2	서버	Json 저장	UI/UX에 적용	POST			
level 3	클라이언트	웹 기반 UI 확인					

Use periodically captured images instead of real-time video.  
If necessary, a mosaic of a person's face will be conducted.

# PART 01 | Flesh out the details

⇒ Task segmentation

	Depth 0	Depth 1	Depth 2	Depth 3	Depth 4			
level 0	Data input	Data local 전송						
level 1	디렉팅	자리	사람	이동중 않은상태 부재중	TRUE TRUE	TRUE TRUE FALSE	TRUE TRUE FALSE	TRUE TRUE
level 2	서버	Json 저장	UI/UX에 적용	POST				
level 3	클라이언트	웹 기반 UI 확인						

Determine whether each seat is in use or empty by combining the presence of a person and objects

# PART 01 | Flesh out the details

⇒ Task segmentation

	Depth 0	Depth 1	Depth 2	Depth 3	Depth 4			
level 0	Data input	Data local 전송						
level 1	디텍팅	자리	사람	이동중 않은상태 부재중	TRUE	TRUE	TRUE TRUE	TRUE TRUE
			물건	여 부	TRUE	FALSE	FALSE	TRUE TRUE
level 2	서버	Json 저장	UI/UX에 적용	POST				
level 3	클라이언트	웹 기반 UI 확인						

Convert seat status information to  
json form

# PART 01 | Flesh out the details

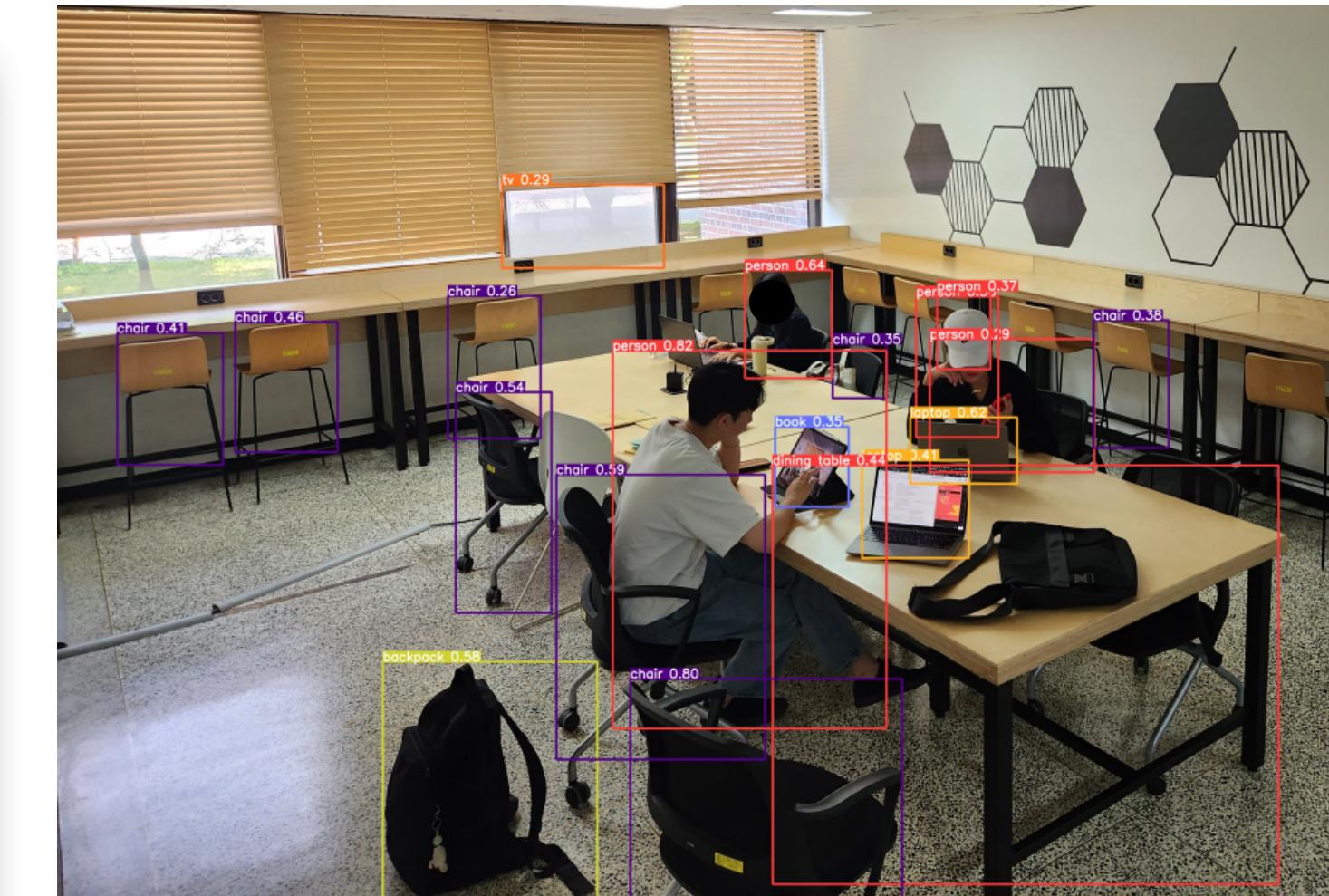
⇒ Task segmentation

	Depth 0	Depth 1	Depth 2	Depth 3	Depth 4			
level 0	Data input	Data local 전송						
level 1	디텍팅	자리	사람	이동중 않은상태 부재중	TRUE	TRUE	TRUE TRUE	TRUE TRUE
			물건	여 부	TRUE	FALSE	FALSE	TRUE TRUE
level 2	서버	Json 저장	UI/UX에 적용	POST				
level 3	클라이언트	웹 기반 UI 확인						

Convert seat status information to  
json form

## PART 02 | Model testing

### YOLOv5

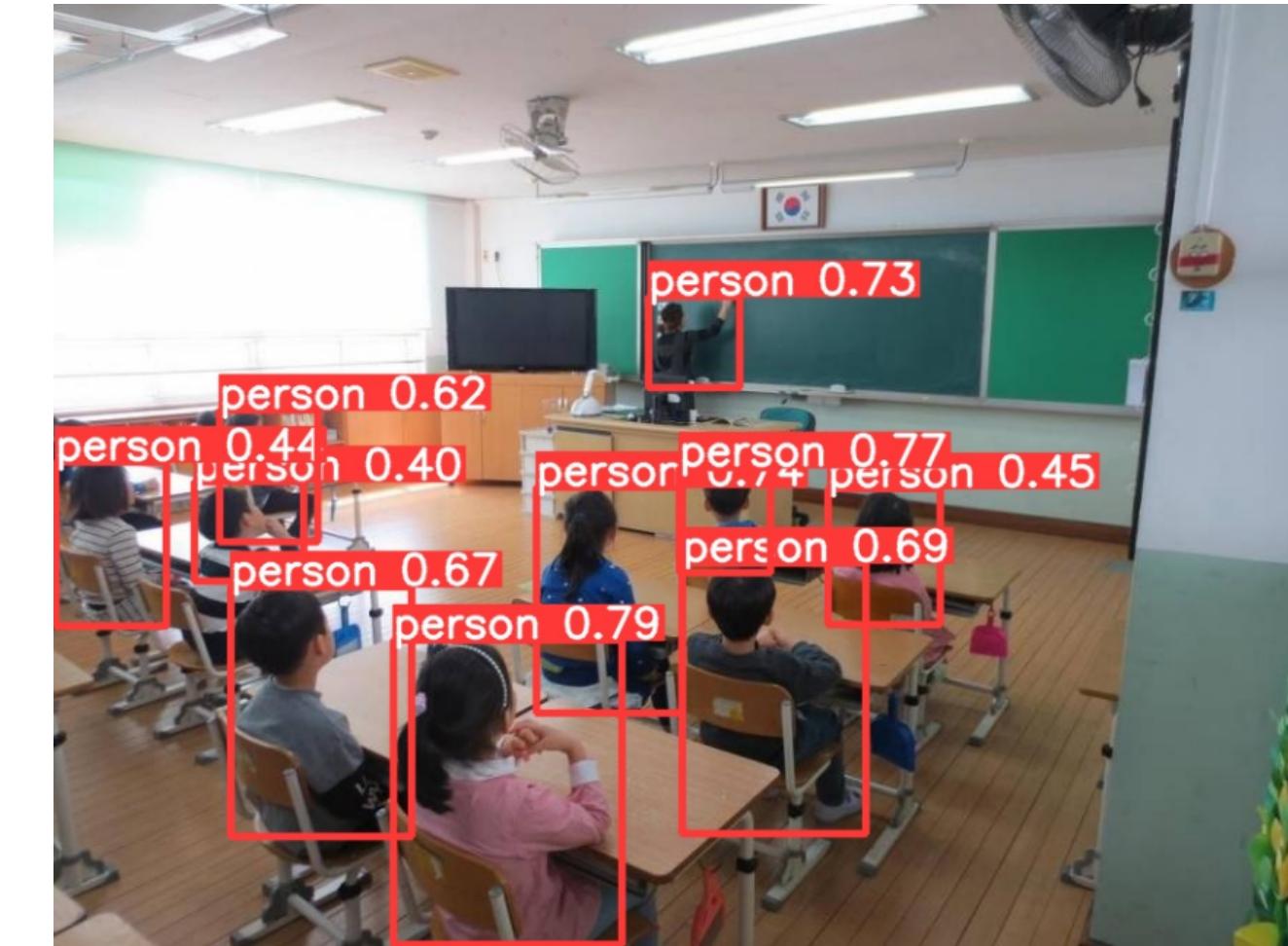


Overall performs well, but occasionally misses obscured seats.

## PART 02 | Model testing

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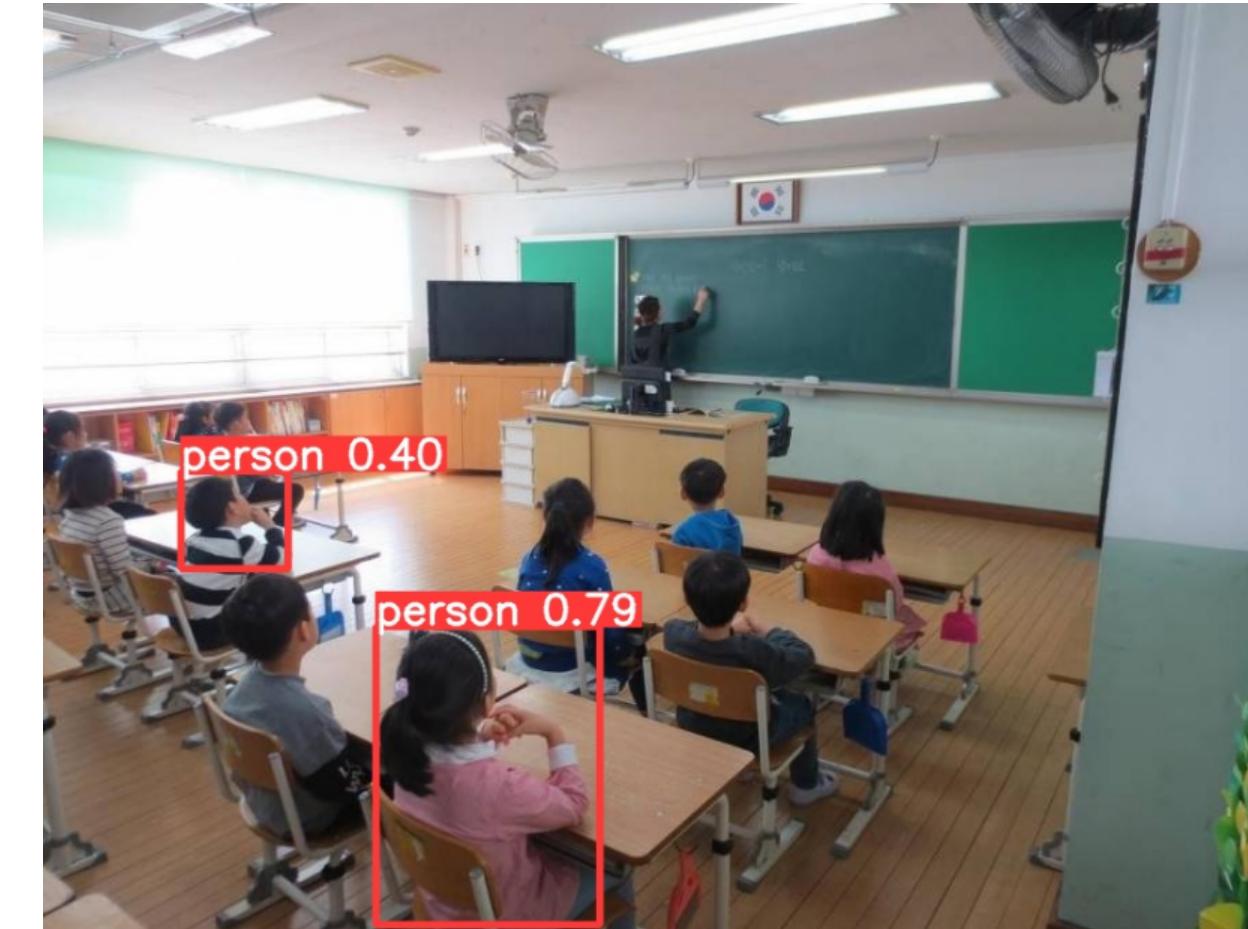
YOLOv5



Good, but if the angles overlap more, some seats may not be detected.

## PART 02 | Model testing

### YOLOv5



**Specify the size for seat detection and perform sequential seat searches to ensure no seats are missed**

# PART 03 | Local server & basic front-end logic implementation

The terminal window shows the contents of `places.json`:

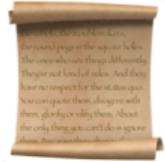
```
{} places.json u x
Projects > E-Seat > places.json > {} 0 > {} 박상조라운지
1 < [ 
2 < { 
3 <   "tmp": { 
4 <     "seat1": false 
5 <   }, 
6 <   "박상조라운지": [ 
7 <     "seat1": true, 
8 <     "seat2": true, 
9 <     "seat3": true, 
10 <    "seat4": true, 
11 <    "seat5": false, 
12 <    "seat6": true, 
13 <    "seat7": false, 
14 <    "seat8": 0, 
15 <    "seat9": true, 
16 <    "seat10": false, 
17 <    "seat11": true, 
18 <    "seat12": true, 
19 <    "seat13": true, 
20 <    "seat14": true, 
21 <    "seat15": true, 
22 <    "seat16": false, 
23 <    "seat17": true, 
24 <    "seat18": true, 
25 <    "seat19": true, 
26 <    "seat20": true 
27 < ] 
]
```

The browser window shows a seating chart with 20 seats labeled 1 through 20. Seats 1, 2, 3, 4, 6, 11, 12, 13, 14, 15, 17, 18, and 20 are green (occupied), while seats 5, 7, 8, 9, and 10 are red (unoccupied).

## Logic

- 1) Local server specifies seat occupancy as boolean values
- 2) Stores them in the database in JSON format
- 3) Client requests seat info
- 4) Server posts the JSON info existing in the database

# PART 04 | LaTeX Document



## [Team A] Proposal written by LaTeX markdown

날짜

October 2, 2023 → October 5, 2023

담당자

김도엽 Jimin Choi 박재윤 Dayeon Woo

상태

진행 중

Date

2023/10/04 → 2023/10/05

태그

LaTex 문서제출

### Efficient empty seat finding technology proposal using object detection: Empty Seat?

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**Abstract** This document proposes a service that offers real-time seat availability information for study spaces within Sungkyunkwan University's Natural Science Campus. The primary objective of the service is to provide convenience to both students and administrators by delivering real-time seat availability information for on-campus study spaces, thereby maximizing space utilization. The service utilizes the object detection model YOLOv5 to analyze seat availability from real-time images and presents this information to users in a user-friendly UI format. This service aims to address the limitations of existing services and assist users in enjoying a more convenient school life.

**Keywords:** Object Detection, YOLOv5, Real-time Server, Real-time seat availability, Study spaces

#### 1 Introduction

At Sungkyunkwan University's Natural Science Campus, there are numerous study spaces available. However, based on experiences, Sungkyunkwan University students have found some inconvenience in using these spaces. Real-time seat availability checking is not possible, making it difficult to anticipate how crowded each space is in advance. Additionally, due to the large campus size, finding a suitable study space can consume a large amount of time and energy. Despite investigating campus services such as the Haedong Library Reservation System, and SKKU CAMPUSMAP, it was insufficient in addressing these difficulties. These services were limited to specific areas or could not provide real-time seat availability information.

Our team believes that "Empty Seats?", which combines the computer vision model YOLOv5 with a user-friendly UI, can address these issues. "Empty Seats?" is a service that allows users to check real-time seat availability in various campus spaces. The operation of the service is as follows: First, it receives real-time images from cameras installed in each space. Next, YOLOv5 is used to detect whether there are individuals seated in each seat in the photo or if objects are placed on the seat. Then, the service determines whether each seat is vacant or in use and visually processes the results to provide users with information on seat availability. Through "Empty Seats?", users can easily assess the availability of empty seats in campus spaces without the need to move around.

## PART 05 | Future plans

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	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
<b>Refinement of the Topic</b>														
<b>AI Model Design</b>														
<b>Data Preprocessing</b>														
<b>Model &amp; Algorithm Implementation</b>														
<b>UI &amp; UX Design &amp; Implementation</b>														
<b>Beta Service Launch</b>														
<b>Incorporation of Feedback &amp; Revisions</b>														

## PART 05 | Future plans

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1

Buying & testing webcams

김도엽

2

Connecting camera & server,  
testing data transmission

김도엽, 박재윤

3

Detecting people & objects  
by YOLOv5

우다연, 최지민

4

Sending seat availability data  
to Server

박재윤, 우다연, 최지민

# THANK YOU

자리 있나요? Empty Seats? TEAM A (A's) 김도엽 박재윤 우다연 최지민